AGRICULTURAL DISC MOUNTING SYSTEM AND METHOD

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to a disc mounting system and method for attaching disc blades to an agricultural implement, such as a disc-ripper, and, more particularly, to such a mounting system and method in which each disc in at least the front disc gangs on the implement is mounted to a gang bar via a respective individual leaf spring. This allows each disc to individually move vertically, laterally and torsionally to relieve stress on the disc blade when an obstacle is encountered.

2. Description of the Related Art

Modern farmers are faced with a variety of problems, including increased concern for soil erosion, crop residue management and rising production costs with stagnant crop prices. One way farmers are successfully addressing each of these concerns is to reduce, as far as possible, the number of passes which a farmer must make over his fields. In corn growing operations, after the corn is harvested, it is important for the farmer to conduct fall tillage to bury the crop residue from the harvested crop and to break up sub-soil compaction in preparation for spring planting. In order to accomplish both of these tasks in a single pass, disc-ripper implements have been developed. Typically a disc ripper has a pair of disc gangs mounted on the front of the implement with the gangs angled inward and rearward toward each other. The front disc gangs are mounted ahead of a number of ripper shanks distributed across the implement. Following the ripper shanks are another pair of disc gangs which are angled inward and forward toward each other.

These disc-rippers, which must be pulled by a large, high horsepower tractor, utilize the front disc gangs to bury the majority of the crop residue. The trailing ripper shanks serve to break up the sub-soil compaction and the trailing rear disc gangs are then used primarily to level any ridges created by the ripper shanks. One of the advantages of a disc-ripper implement is the tendency of the ripper shanks to drive deep into the soil, which makes the entire implement stay in the ground and work the soil consistently. At the same time, the discs are pulled down into the soil by the action of the ripper shanks, which causes them to be consistently buried and working as well. This means that the implement will also tend to stay in the soil and not ride up and over obstacles, such as rocks or extreme hard spots. This means that some relief must be afforded to the disc gangs, particularly on the front of the implement, to prevent the disc mounts from being damaged or the disc blades from being bent or broken as they encounter these obstacles.

In order to address these needs, prior art disc-rippers have attached the discs in a number of different ways. Often the discs are ganged together spindle to spindle and the entire interconnected gang is attached to a gang bar via spring mounts, such as U or C shaped leaf springs or compression coil springs. A problem with this arrangement is the requirement for the entire disc gang to ride up and out of the ground when any of the discs encounters an obstacle, which can result in broken individual discs in the gang and/or large undisced gaps in the field as the entire gang rides up and out of the soil and then settles back down into the soil.

In order to counteract these problems, it is known to provide individual spindle arms for each disc, with each arm having its own compression spring. This arrangement allows each disc in a gang to individually flex backward and upward through an arc dictated by the length of the arm. While this arrangement is an improvement on ganged discs, the discs are required to travel through a relatively long arc in order to clear an obstruction. In addition, if the obstacle encountered is slightly off center of the disc travel, a large amount of side load can be imparted to the disc, often resulting in bending or twisting of the arm, damage to the disc spindle or bearings or even breakage of the disc blade.

At least one prior art attempt has been made to attach individual discs to an implement via respective leaf springs. U.S. Pat. No. 2,750,861 to Robert Erwin, and entitled Mounting for Disc Type Soil Working Tools, is directed to such an arrangement. In the Erwin patent, a substantially U shaped leaf spring is attached, at an upper leg, to a seed hopper and, at a lower leg, to a disc mounting bracket. However, the leaf spring in Erwin extends across the top of the respective disc and extends at a considerable angle with respect to the path of travel of that disc. This arrangement allows the disc to be vertically deflected, but, intentionally, acts to restrain any lateral or twisting motion of the spring and disc. Thus, the Erwin leaf spring mounting system suffers from the same shortcomings as the coil spring mount described above.

It is clear then, that a need still exists for a disc mounting mechanism for ganged disc implements and disc-rippers which allows each individual disc freedom to move away from obstacles and hard spots. Such a disc mounting mechanism should preferably allow each disc to individually move vertically, laterally and torsionally to avoid obstacles without damage to the disc and mounting mechanism. The disc mounting mechanism should also allow debris and trash to freely flow through the discs without impeding the operation of the implement.

SUMMARY OF THE INVENTION

In the practice of the present invention, an agricultural implement, such as a disc-ripper, has front and rear pairs of disc gangs, each of which has a disc gang bar. Each disc in at least the front disc gang pairs is individually attached to the respective disc gang bar via a dedicated leaf spring. Each of the leaf springs, which can be generally U shaped, are attached, via an upper leg, to the gang bar and, via a lower leg, to a disc spindle. The leaf springs can either extend straight down from the gang bar or be laterally offset, but are preferably laterally offset, following the concavity of the disc mounted thereon. This allows for better residue flow through the discs. The leaf springs are also preferably mounted parallel to the cutting edge of the attached disc. This position provides for increased lateral flexibility as well as for the most efficient residue flow around the discs. The bottom end of each leaf spring is bolted or otherwise attached to a weldment which includes a disc spindle. The bolting of each disc spindle to a respective leaf spring allows quick and easy replacement of the spindle in the event of damage. The welded spindle preferably is set at an angle such that the bottom of an attached disc blade runs outward from the top of that blade. This allows soil and residue to flow out the back of the disc instead of being carried up and over the top of the spindle. An optimum angle for these spindles appears to be about 8 degrees from horizontal, but a range of 3 to 15 degrees is possible. An optional shield can be installed on each leaf spring which shield is attached to the top of the spring and covers the side and rear openings of the U shaped spring. The shield prevents soil and residue from being thrown into the spring from the concave side of the neighboring disc. By attaching the shield only at the top of the spring, the spring is free to move but the over-sized

shield still acts to prevent residue and soil from entering the spring openings. A scraper can be attached to the shield. Finally, in an alternative embodiment, a disc spindle can be inserted directly through a bore extending through the spring lower leg.

OBJECTS AND ADVANTAGE OF THE PRESENT INVENTION

The objects and advantages of the present invention include: providing an improved agricultural disc mounting system and method; providing such a mounting system and method in which each disc is attached to a disc gang bar via a respective individual leaf spring; providing such a system and method in which each leaf spring is arranged roughly in a U-shape with an upper leg attached to the gang bar and a lower leg attached to a disc spindle; providing such a disc mounting system and method in which individual discs are permitted to flex vertically, laterally and torsionally to relieve stress on the disc blade when an obstacle is encountered; providing such a mounting system and method which allows efficient flow through of soil and residue through the discs; providing such a mounting system and method in which individual springs are provided with shields to prevent soil and residue from being thrown into the spring from adjacent discs; providing such a disc mounting system which is more efficient and better designed for operation in rough terrain and wet soil conditions than prior art mounting systems and methods; and providing such a disc mounting system and method which is efficient and convenient in operation and which is particularly well adapted for the proposed usage thereof.

Other objects and advantages of this invention will become apparent from the following description taken in conjunction with the accompanying drawings wherein are set forth, by way of illustration and example, certain embodiments of this invention.

The drawings constitute a part of this specification and include exemplary embodiments of the present invention and illustrate various objects and features thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a disc-ripper-disc agricultural implement with a pair of front disc gangs, each of which mount a plurality of discs in accordance with the inventive disc mounting system and method.

FIG. 2 is a fragmentary, side elevational view of a prior art disc mounting system using individual coil spring loaded arms, and illustrating a down position in solid lines and a deflected position in dotted lines.

FIG. 3 is a greatly enlarged, fragmentary perspective view of a portion of the implement of FIG. 1, illustrating a pair of discs attached to a gang bar using the inventive attachment system and method, with the mounting system shown without an optional shield for ease of illustration.

FIG. 4 is a greatly enlarged side elevational view of a disc mounted via the inventive disc mounting system and method, illustrating, in dotted lines, vertical deflection of the disc and spring.

FIG. 5 is a greatly enlarged rear elevational view of a disc mounted via the inventive disc mounting system and method, illustrating, in dotted lines, lateral deflection of the disc and spring.

FIG. 6 is a greatly enlarged rear elevational view of a disc mounted via the inventive disc mounting system and method, illustrating, in dotted lines, torsional deflection of the disc and spring.

FIG. 7 is an exploded, perspective vis of a disc and inventive disc mounting system, illustrating an optional shield and scraper blade.

FIG. 8 is a perspective view of a disc attached to an alternative embodiment of leaf spring which integrally incorporates a horizontal bore to directly receive a disc spindle.

FIGS. 9, 10, 11, and 12 are respective different spring configurations usable with the inventive disc mounting system and method.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

I. Introduction and Environment

As required, detailed embodiments of the present invention are disclosed herein; however, it is to be understood that the disclosed embodiments are merely exemplary of the invention, which may be embodied in various forms. Therefore, specific structural and functions details disclosed herein are not to be interpreted as limiting, but merely as a basis for the claims and as a representative basis for teaching one skilled in the art to variously employ the present invention in virtually any appropriately detailed structure.

Certain terminology will be used in the following description for convenience and reference only and will not be limiting. For example, the words "up", "down", "right" and "left" will refer to directions in the drawings to which reference is made. The words "in" and "out" will refer to directions toward and away from, respectively, the geometric center of the structure being referred to. Said terminology will include the words specifically mentioned derivatives thereof and words of similar import.

II. Prior Art

Referring to the drawings in more detail, and with particular reference to FIG. 2, a prior art individual disc mounting system is illustrated. In this prior art system, each disc **1** is attached to a disc gang bar **2** via a mounting mechanism, generally indicated at **3**. The mounting mechanism **3** includes a spindle **4** to which the disc **1** is attached via a bearing **5**. The spindle **4** is rotatably attached to a swing arm **11** which, in turn, is pivotably attached to a mounting bracket **12**. The bracket **12** is attached to the gang bar **2** via a pair of U shaped, threaded rods **13** which wrap around the gang bar **2** and which extend through respective bores in the bracket **12** with respective nuts **14** acting to hold them in place. A spring shaft **15** is pivotally attached at one end to a pair of ears **16** extending outward from the swing arm **11**, extends through a bore in a plate **21** which extends downward from the bracket **12**, and through a coil spring **22**, a cup shaped flange **23**, a washer **24** and terminates in a threaded nut **25**.

In the prior art mounting system **3**, the spring **22** acts to pull the swing arm **11**, and the attached disc **1**, forward to an operating position, as shown in solid lines in FIG. 2. When the disc **1** strikes an obstacle, such as a rock or other obstruction, the disc **1** will be forced backward against the action of the spring **22** to the position indicated in dotted lines in FIG. 2. This action does work somewhat to protect the disc **1** and other components from breakage when the obstacle is encountered in line with the direction of travel of the disc **1**. However, when an obstacle is encountered which is positioned even slightly to the side of the disc travel direction, a large amount of side load is imparted to the disc **1**, which, even with the relief provided by the spring **22**, can bend or twist the swing arm **11**, damage the spindle **4** and associated bearings, or even break the disc **1**.

III. Inventive Disc Mounting System and Method

FIG. 1 illustrates an agricultural disc-ripper-disc implement, generally indicated at **31**. The implement **31** includes a pair of front disc gangs **32** and **33** and a pair of rear disc gangs **34** and **35**, each of which includes a respective disc gang bar **40** which is supported by a transverse, angled disc gang support arm **41**. The front disc gangs **32** and **33** are preferably positioned at respective converging angles which extend inward and rearward from outside to inside, while the rear disc gangs **34** and **35** are preferably positioned at respective converging angles which extend inward and forward from outside to inside. Each disc gang **32–35** supports a plurality of disc blades **42**.

The implement **31** includes a frame including four longitudinal frame members **43** interconnected by, in addition to the disc support arms **41**, a front transverse frame member **44**, a transverse wheel support frame member **45**, an angled transverse frame member **51** and a short, intermediate transverse frame member **52**. A pair of torque tubes **53** are connected to a respective pair of tandem wheels **54** which support the implement **31** as well as providing depth adjustment, in a known manner.

A plurality of ripper shanks **55** are attached, at various positions along the transverse frame members **45**, **51**, and **52** via respective spring loaded automatic shank resets **61**. The ripper shanks **55** are thus positioned between the front disc gangs **32** and **33** and the rear disc gangs **34** and **35**. The disc-ripper-disc arrangement of the implement **31** is designed to utilize the disc blades **42** in the front disc gangs **32** and **33** to bury the majority of crop residue in a field. The trailing ripper shanks **55** serve to break up any sub-soil compaction and the disc blades **42** within the trailing disc gangs **34** and **35** are used primarily to level any ridges created by the ripper shanks **55**. As stated earlier, the ripper shanks **55** tend to drive deep into the soil, which pulls the disc blades **42** in the front and rear disc gangs **32–35** down into the soil by the action of the ripper shanks **55**, which causes the disc blades **42** to be consistently buried and working as well. This means that the implement **31** will tend to stay in the soil and not ride up and over obstacles, such as rocks or extreme hard spots. With this arrangement, it is important that the disc blades **42**, particularly on the front disc gangs **32** and **33** be individually, resiliently mounted to their respective gang bars **40** to prevent the disc blades **42** and mounts from being damaged or broken. However, the prior art individual disc mounting system, as illustrated in FIG. **2**, is inadequate for the reasons stated earlier.

The inventive disc mounting system is better illustrated in FIGS. **3–7**, and is generally indicated at **61**. Only a portion of the left disc gang bar **32** is illustrated, it being understood that the right disc gang bar is a mirror image thereof. In the mounting system **61**, each front disc blade **42** is attached to a disc spindle **62**, which is attached to a weldment **63** with a generally horizontal plate **64**. The plate **64** is bolted to a bottom side of a lower leg **65** of a U shaped leaf spring **70** with a closed end **71** of the "U" facing forward. An upper leg **72** of the spring **70** is attached to the disc gang bar **40** by sandwiching it between a pair of clamping plates **73** and **74**. The clamping plates, in turn, are attached to the disc gang bar **40** via a plurality of bolts **75** which extend upward on either side of the bar **32** and through the top clamping plate **73**, and which are secured in place by a like plurality of nuts **76**. One of the bolts **75** preferably extends through a bore in the spring upper leg **72**.

The upper leg **72** of the spring **70** is preferably offset from the lower leg **65**, the closed end **71** of the spring **70** extends downward at an angle with respect to vertical, as shown in FIG. **5**, which angle approximately follows the concavity of the disc blade **42**. This offset angle allows for better residue flow between adjacent disc blades **42**. The disc spindles **62** are mounted in a range of ¼ to 1 times the diameter of the disc blade **42** away from the front of the spring closed end **71**. The disc spindles **62** are preferably positioned at an angle with respect to horizontal to allow the bottom of each disc blade **42** to run outward with respect to the top of that disc blade **42**. This allows soil and residue to flow out the back of the disc blade **42** rather than being carried up and over the spindle **62**. By contrast, if the spindle were perfectly horizontal, the concavity of the disc blades **42** would tend to hold the soil and residue in and bring it up and over the top of the hub and spindle, resulting in "plugging" of the discs. An optimum angle for the spindles **62** has been found to be approximately eight degrees, but a range of 5 degrees either side of that can be effective as well.

Referring to FIG. **7**, a shield **81** is formed from a single plate which is bent to include a large side covering portion **83**, a rear covering portion **84** and a top, attachment portion **85** with a plurality of attachment bores **91** extending there through. Each shield **81** can be attached to a respective spring **70** by extending the bolts **75** through the attachment bores **91** prior to securing them via the nuts **76**. The shield **81** is thus secured to the spring **70** only at the top thereof, which allows the spring **70** to freely flex, but the shield **81** is still maintained in covering relation with a spring side opening **92** and front opening **93**. A contoured scraper blade **94** can be attached to the rear covering portion **84** of the shield **81** via threaded bores **95** in the rear covering portion **84**. The scraper blade **94** acts to scrape the concave surface of the disc blade **42** as it rotates.

IV. Operation of the Disc Mounting System and Method

Referring to FIGS. **4–6**, a number of different disc deflection positions are schematically illustrated. FIG. **4** illustrates a disc blade **42** and spring **70** in solid lines in a working position and, in dotted lines, flexing vertically. Thus, if the disc blade **42** encounters an obstacle directly in it's path, it has the freedom to deflect vertically to prevent damage. FIG. **5** illustrates the disc blade **42** and spring **70** in solid lines in a working position and, in dotted lines, flexing laterally. Thus, if the disc blade **42** encounters a large obstacle which is positioned to one side or the other, or encounters other difficult situations, such as wet soil conditions, it has the freedom to deflect laterally to prevent damage. Finally, FIG. **6** illustrates the disc blade **42** and spring **70** in solid lines in a working position and, in dotted lines, flexing torsionally. Thus, if the disc blade **42** encounters an obstacle which is positioned such that just the lower portion of the disc blade **42** is forced sideways, it has the freedom to deflect torsionally to prevent damage. Of course, FIGS. **4–6** show simplistic deflection positions for ease of illustration, but any combination of vertical, lateral and/or torsional deflection can be accommodated in one motion by the inventive disc mounting system **61**.

V. Alternative Embodiments of the Disc Mounting System and Method

FIG. **8** illustrates an alternative embodiment of U shaped spring **101** which includes an upper leg **102** which is essentially identical to the upper leg **72** of the spring **70**. The spring **101** also includes a closed end **103** and a lower leg **104** which lower leg **104** includes a taper **105** which results in a substantially vertical spindle receiving portion **111**. The spindle receiving portion **111** includes a through bore **112** which is sized to receive a modified disc spindle **113**. The disc spindle **113** includes a circular collar **115** which abuts the spring spindle receiving portion **111** on one side thereof